Claims

[c1] 1. A spindle motor, comprising:

a shaft;

a sleeve formed with a through-hole for rotary-play insertion of the shaft;

a rotor having a round top plate in the rotational center of which the shaft is constituted integrally, and a circular cylindrical wall depending from the top plate along its outer rim;

a cover member for closing over one end of the through-hole formed in the sleeve;

micro-gaps formed continuing between an upper-end face of said sleeve and a bottom face of said rotor top plate, an inner circumferential surface of said sleeve and an outer circumferential surface of said shaft, and an inner face of said cover member and an end face of said shaft;

oil retained continuously without interruption within said micro-gaps throughout their entirety;

a radial dynamic pressure bearing section configured between said sleeve inner-circumferential surface and said shaft outer-circumferential surface, for inducing hydrodynamic pressure into said oil when said rotor spins;

a thrust bearing section configured on at least one of either said sleeve upper-end face or said top plate bottom face, and furnished with dynamic-pressure-generating striations for imparting to said oil radially inward-heading pressure when said rotor spins;

herringbone grooves being a contiguous pair of spiral grooves for generating essentially equal pressure, provided as dynamic-pressure-generating striations in said radial dynamic-pressure bearing section; and

an axial support section, formed between said cover member inner face and said shaft end face, having pressure essentially balancing radially inward-heading pressure generated in said thrust bearing section, wherein said rotor is lifted through cooperation of said thrust bearing section and said bearing section.

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[c2] 2. A spindle motor as set forth in claim 1:

an outer circumferential surface of said sleeve and an inner circumferential

surface of said rotor circular cylindrical wall opposing via a radial gap; and said sleeve along its outer circumferential surface being provided with a taper surface constricting in outer diameter according as its separation from said rotor top plate; wherein

said oil is retained by a meniscus forming in between said taper surface and the inner-circumferential surface of said rotor circular cylindrical wall.

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[c3] 3. A spindle motor as set forth in claim 2, wherein:

a stepped portion continuous with said taper surface is provided in said sleeve by recessing its outer circumferential surface radially inwardly;

an annular member projecting radially inward corresponding to the stepped portion is fixedly fitted into the inner circumferential surface of said rotor circular cylindrical wall, and a rotor retainer is constituted by engagement of the stepped portion and the annular member;

a micro-gap, smaller than the minimum clearance of the radial gap formed between the taper surface of said sleeve and the inner circumferential surface of said rotor circular cylindrical wall, is formed to function as a labyrinth seal between said annular member along its upper face and said sleeve stepped portion along its undersurface.

[c4] 4. A spindle motor as set forth in claim 1, wherein said radial dynamic-pressure bearing section is configured between said shaft outer-circumferential surface and said sleeve inner-circumferential surface as an axially separated pair of radial dynamic-pressure bearings.

[c5] 5. A spindle motor as set forth in claim 1, wherein said rotor is urged in a direction toward said cover member by axially acting magnetic force.

[c6] 6. A spindle motor comprising:

a shaft;

a sleeve formed with a through-hole for rotary-play insertion of the shaft;

a rotor having a round top plate in the rotational center of which the shaft is furnished united, and a circular cylindrical wall depending from the top plate along its outer rim;

a cover member for closing over one end of the through-hole formed in the

sleeve;
a circular cylindrical casing member fitted to said shaft over its outer circumferential surface
micro-gaps formed continuing between an upper-end face of said sleeve and a bottom face of said rotor top plate, an inner circumferential surface of said sleeve and an outer circumferential surface of said casing member, and an inner face of said cover member and end faces of said shaft and said casing member;
oil retained continuously without interruption within said micro-gaps throughout their entirety;
a radial dynamic-pressure bearing section configured intermediarily by at least one surface of either said sleeve inner-circumferential surface or said casing member outer-circumferential surface, and by said oil when said rotor spins, and provided with, as dynamic-pressure-generating striations, herringbone grooves being a contiguous pair of spiral grooves, for inducing into said oil when said rotor spins hydrodynamic pressure whose pressure gradient becomes axially symmetrical;
a thrust bearing section configured on at least one of either said sleeve upper-end face or said top plate bottom face, and furnished with dynamic-pressure-generating striations for imparting to said oil radially inward-heading pressure when said rotor spins;
an axial support section, formed between said cover member inner face and said shaft end face, having pressure essentially balancing radially inward-heading pressure generated in said thrust bearing section, wherein said rotor is lifted through cooperation of said thrust bearing section and said bearing section; and
a communicating pathway formed in between said shaft along its outer circumferential surface and said casing member along its inner circumferential surface, for communicating said oil retained in, and enabling it to circulate between, the micro-gap formed between said sleeve upper-end face and the bottom face of said rotor top plate, and the micro-gap formed between said cover member inner face and said shaft and casing member end faces.

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[c7]

7. A spindle motor as set forth in claim 6:

a helical groove being formed on the outer circumferential surface of said shaft in a single path running from its upper-end portion to its lower-end portion; wherein

fitting said casing member over the outer circumferential surface of said shaft defines said communicating pathway between said helical groove and the inner circumferential surface of said casing member.

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[c8] 8. A spindle motor as set forth in claim 6:

an outer circumferential surface of said sleeve and an inner circumferential surface of said rotor circular cylindrical wall opposing via a radial gap; and

said sleeve outer circumferential surface being provided with a taper surface constricting in outer diameter according as its separation from said rotor top plate; wherein

and said oil is retained by a meniscus forming in between said taper surface and the inner-circumferential surface of said rotor circular cylindrical wall.

[c9] 9. A spindle motor as set forth in claim 8, wherein:

a stepped portion continuous with said taper surface is provided in said sleeve by recessing its outer circumferential surface radially inwardly;

an annular member projecting radially inward corresponding to the stepped portion is fixedly fitted into the inner-circumferential surface of said rotor circular cylindrical wall, and a rotor retainer is constituted by engagement of the stepped portion and the annular member;

a micro-gap smaller than the minimum clearance of the radial gap formed between the taper surface of said sleeve and the inner-circumferential surface of said rotor circular cylindrical wall, is formed to function as a labyrinth seal between the annular member along its upper face and said sleeve stepped portion along its undersurface.

[c10] 10. A spindle motor as set forth in claim 6, wherein said rotor is urged in a direction toward said cover member by axially acting magnetic force.

[c11] 11. A spindle motor, comprising:

a shaft;

a sleeve formed with a through-hole for rotary-play insertion of the shaft;

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a rotor having a round top plate in the rotational center of which the shaft is constituted integrally, and a circular cylindrical wall depending from the top plate along its outer rim;

a thrust bearing section configured on at least one of either said sleeve upper-end face or said top plate bottom face, and furnished with dynamic-pressure-generating striations for imparting to said oil radially inward-heading pressure when said rotor spins;

a radial dynamic pressure bearing section configured between said sleeve inner-circumferential surface and said shaft outer-circumferential surface, for inducing hydrodynamic pressure into said oil when said rotor spins;

an annular flange portion with which said sleeve is provided wherein its outer circumferential surface flares radially outward, and an annular member, projecting radially inward in a location corresponding to said flange portion along its underside, fixedly fitted into an inner circumferential surface of said rotor circular cylindrical wall, a rotor retainer being constituted by engagement of the flange portion and the annular member; wherein

said annular member is harder at least superficially than said sleeve.

[c12] 12. A spindle motor as set forth in claim 11, wherein said annular member is formed from a ceramic material.

[c13] 13. A spindle motor as set forth in claim 11, wherein said annular member is formed from a surface-hardened metal material.

[c14]

14. A spindle motor as set forth in claim 11, wherein:

one end of the through-hole formed in the sleeve is closed over by a cover member;

micro-gaps are formed continuing between an upper-end face of said sleeve and a bottom face of said rotor top plate, an inner circumferential surface of said sleeve and an outer circumferential surface of said shaft, and an inner face of said cover member and an end face of said shaft, meanwhile oil is retained continuously without interruption within said micro-gaps throughout their entirety; and

herringbone grooves being a contiguous pair of spiral grooves for generating

essentially equal pressure are provided as dynamic-pressure-generating striations in said radial dynamic-pressure bearing section, an axial support section is formed between said cover member inner face and said shaft end face, having pressure essentially balancing radially inward-heading pressure generated in said thrust bearing section, wherein said rotor is lifted through cooperation of said thrust bearing section and said bearing section, meanwhile said rotor is magnetically urged in a direction axially opposing its lifting direction.

Sub A1 cont

[c15] 15. A spindle motor as set forth in claim 11:
said flange portion along its outer circumferential surface and said rotor circular cylindrical wall along its inner circumferential surface opposing via a radial gap; and
said flange portion along its outer circumferential surface being provided with a taper surface constricting in outer diameter according as its separation from said rotor top plate; wherein
said oil is retained by a meniscus forming in between said taper surface and the inner-circumferential surface of said rotor circular cylindrical wall, meanwhile a micro-gap, smaller than the minimum clearance of the radial gap formed between the taper surface along said flange portion outer circumferential surface and the inner circumferential surface of said rotor circular cylindrical wall, is formed to function as a labyrinth seal between said annular member along its upper face and said flange portion along its undersurface.

[c16] 16. A disk-drive device including a housing, a spindle motor fixed inside said housing for spinning recording disks, and an information access means for writing information into and reading information out from needed locations on the recording disks, wherein said spindle motor comprises:
a shaft;
a sleeve formed with a through-hole for rotary-play insertion of the shaft;
a rotor having a round top plate in the rotational center of which the shaft is constituted integrally, and a circular cylindrical wall depending from the top plate along its outer rim;
a cover member for closing over one end of the through-hole formed in the

sleeve;
micro-gaps formed continuing between an upper-end face of said sleeve and a bottom face of said rotor top plate, an inner circumferential surface of said sleeve and an outer circumferential surface of said shaft, and an inner face of said cover member and an end face of said shaft;
oil retained continuously without interruption within said micro-gaps throughout their entirety;
a radial dynamic pressure bearing section configured between said sleeve inner-circumferential surface and said shaft outer-circumferential surface, for inducing hydrodynamic pressure into said oil when said rotor spins;
a thrust bearing section configured on at least one of either said sleeve upper-end face or said top plate bottom face, and furnished with dynamic-pressure-generating striations for imparting to said oil radially inward-heading pressure when said rotor spins;
herringbone grooves being a contiguous pair of spiral grooves for generating essentially equal pressure, provided as dynamic-pressure-generating striations in said radial dynamic-pressure bearing section; and
an axial support section, formed between said cover member inner face and said shaft end face, having pressure essentially balancing radially inward-heading pressure generated in said thrust bearing section, wherein said rotor is lifted through cooperation of said thrust bearing section and said bearing section.

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[c17] 17. A disk-drive device as set forth in claim 16:
an outer circumferential surface of said sleeve and an inner circumferential surface of said rotor circular cylindrical wall opposing via a radial gap; and
said sleeve along its outer circumferential surface being provided with a taper surface constricting in outer diameter according as its separation from said rotor top plate; wherein
said oil is retained by a meniscus forming in between said taper surface and the inner-circumferential surface of said rotor circular cylindrical wall.

[c18] 18. A disk-drive device as set forth in claim 17, wherein:
a stepped portion continuous with said taper surface is provided in said sleeve

by recessing its outer circumferential surface radially inwardly;
an annular member projecting radially inward corresponding to the stepped portion is fixedly fitted into the inner circumferential surface of said rotor circular cylindrical wall, and a rotor retainer is constituted by engagement of the stepped portion and the annular member;
a micro-gap, smaller than the minimum clearance of the radial gap formed between the taper surface of said sleeve and the inner circumferential surface of said rotor circular cylindrical wall, is formed to function as a labyrinth seal between said annular member along its upper face and said sleeve stepped portion along its undersurface.

Sub A17 con't

[c19] 19. A disk-drive device as set forth in claim 16, wherein said radial dynamic-pressure bearing section is configured between said shaft outer-circumferential surface and said sleeve inner-circumferential surface as an axially separated pair of radial dynamic-pressure bearings.

[c20] 20. A disk-drive device as set forth in claim 16, wherein said rotor is urged in a direction toward said cover member by axially acting magnetic force.

[c21]

21. A disk-drive device including a housing, a spindle motor fixed inside said housing for spinning recording disks, and an information access means for writing information into and reading information out from needed locations on the recording disks, wherein said spindle motor comprises:
a shaft;
a sleeve formed with a through-hole for rotary-play insertion of the shaft;
a rotor having a round top plate in the rotational center of which the shaft is furnished united, and a circular cylindrical wall depending from the top plate along its outer rim;
a cover member for closing over one end of the through-hole formed in the sleeve;
a circular cylindrical casing member fitted to said shaft over its outer circumferential surface
micro-gaps formed continuing between an upper-end face of said sleeve and a bottom face of said rotor top plate, an inner circumferential surface of said

sleeve and an outer circumferential surface of said casing member, and an inner face of said cover member and end faces of said shaft and said casing member; oil retained continuously without interruption within said micro-gaps throughout their entirety;

Sub A1 con't

a radial dynamic-pressure bearing section configured intermediarily by at least one surface of either said sleeve inner-circumferential surface or said casing member outer-circumferential surface, and by said oil when said rotor spins, and provided with, as dynamic-pressure-generating striations, herringbone grooves being a contiguous pair of spiral grooves, for inducing into said oil when said rotor spins hydrodynamic pressure whose pressure gradient becomes axially symmetrical;

a thrust bearing section configured on at least one of either said sleeve upper-end face or said top plate bottom face, and furnished with dynamic-pressure-generating striations for imparting to said oil radially inward-heading pressure when said rotor spins;

an axial support section, formed between said cover member inner face and said shaft end face, having pressure essentially balancing radially inward-heading pressure generated in said thrust bearing section, wherein said rotor is lifted through cooperation of said thrust bearing section and said bearing section; and

a communicating pathway formed in between said shaft along its outer circumferential surface and said casing member along its inner circumferential surface, for communicating said oil retained in, and enabling it to circulate between, the micro-gap formed between said sleeve upper-end face and the bottom face of said rotor top plate, and the micro-gap formed between said cover member inner face and said shaft and casing member end faces.

[c22]

22. A disk-drive device as set forth in claim 21:

a helical groove being formed on the outer circumferential surface of said shaft in a single path running from its upper-end portion to its lower-end portion; wherein

fitting said casing member over the outer circumferential surface of said shaft defines said communicating pathway between said helical groove and the inner

circumferential surface of said casing member.

[c23] 23. A disk-drive device as set forth in claim 21:
an outer circumferential surface of said sleeve and an inner circumferential surface of said rotor circular cylindrical wall opposing via a radial gap; and
said sleeve outer circumferential surface being provided with a taper surface constricting in outer diameter according as its separation from said rotor top plate; wherein
and said oil is retained by a meniscus forming in between said taper surface and the inner-circumferential surface of said rotor circular cylindrical wall.

Sub A1 cont

[c24] 24. A disk-drive device as set forth in claim 23, wherein:
a stepped portion continuous with said taper surface is provided in said sleeve by recessing its outer circumferential surface radially inwardly;
an annular member projecting radially inward corresponding to the stepped portion is fixedly fitted into the inner-circumferential surface of said rotor circular cylindrical wall, and a rotor retainer is constituted by engagement of the stepped portion and the annular member;
a micro-gap smaller than the minimum clearance of the radial gap formed between the taper surface of said sleeve and the inner-circumferential surface of said rotor circular cylindrical wall, is formed to function as a labyrinth seal between the annular member along its upper face and said sleeve stepped portion along its undersurface.

[c25] 25. A disk-drive device as set forth in claim 21, wherein said rotor is urged in a direction toward said cover member by axially acting magnetic force.

[c26] 26. A disk-drive device including a housing, a spindle motor fixed inside said housing for spinning recording disks, and an information access means for writing information into and reading information out from needed locations on the recording disks, wherein said spindle motor comprises:
a shaft;
a sleeve formed with a through-hole for rotary-play insertion of the shaft;
a rotor having a round top plate in the rotational center of which the shaft is constituted integrally, and a circular cylindrical wall depending from the top

plate along its outer rim;
a thrust bearing section configured on at least one of either said sleeve upper-end face or said top plate bottom face, and furnished with dynamic-pressure-generating striations for imparting to said oil radially inward-heading pressure when said rotor spins;
a radial dynamic pressure bearing section configured between said sleeve inner-circumferential surface and said shaft outer-circumferential surface, for inducing hydrodynamic pressure into said oil when said rotor spins;
an annular flange portion with which said sleeve is provided wherein its outer circumferential surface flares radially outward, and an annular member, projecting radially inward in a location corresponding to said flange portion along its underside, fixedly fitted into an inner circumferential surface of said rotor circular cylindrical wall, a rotor retainer being constituted by engagement of the flange portion and the annular member; wherein
said annular member is harder at least superficially than said sleeve.

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[c27] 27. A disk-drive device as set forth in claim 26, wherein said annular member is formed from a ceramic material.

[c28] 28. A disk-drive device as set forth in claim 26, wherein said annular member is formed from a surface-hardened metal material.

[c29]

29. A disk-drive device as set forth in claim 26, wherein:
one end of the through-hole formed in the sleeve is closed over by a cover member;
micro-gaps are formed continuing between an upper-end face of said sleeve and a bottom face of said rotor top plate, an inner circumferential surface of said sleeve and an outer circumferential surface of said shaft, and an inner face of said cover member and an end face of said shaft, meanwhile oil is retained continuously without interruption within said micro-gaps throughout their entirety; and
herringbone grooves being a contiguous pair of spiral grooves for generating essentially equal pressure are provided as dynamic-pressure-generating striations in said radial dynamic-pressure bearing section, an axial support

section is formed between said cover member inner face and said shaft end face, having pressure essentially balancing radially inward-heading pressure generated in said thrust bearing section, wherein said rotor is lifted through cooperation of said thrust bearing section and said bearing section, meanwhile said rotor is magnetically urged in a direction axially opposing its lifting direction.

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[c30] 30. A spindle motor as set forth in claim 29:
said flange portion along its outer circumferential surface and said rotor circular cylindrical wall along its inner circumferential surface opposing via a radial gap; and
said flange portion along its outer circumferential surface being provided with a taper surface constricting in outer diameter according as its separation from said rotor top plate; wherein
said oil is retained by a meniscus forming in between said taper surface and the inner-circumferential surface of said rotor circular cylindrical wall, meanwhile a micro-gap, smaller than the minimum clearance of the radial gap formed between the taper surface along said flange portion outer circumferential surface and the inner circumferential surface of said rotor circular cylindrical wall, is formed to function as a labyrinth seal between said annular member along its upper face and said flange portion along its undersurface.